

Landsat 8 WELD compositing - a CONUS one year analysis

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U.S. Forest Service Science Team Meeting
Oregon Northwest Research Station, Corvallis, OR
July 22-24 2014

Original Presentation Title



Collections

- └── weld.global.annual.2010
- └── weld.global.month01.2010
- └── weld.global.month02.2010
- └── weld.global.month03.2010
- └── weld.global.month04.2010
- └── weld.global.month05.2010
- └── weld.global.month06.2010
- └── weld.global.month07.2010
- └── weld.global.month08.2010
- └── weld.global.month09.2010
- └── weld.global.month10.2010
- └── weld.global.month11.2010
- └── weld.global.month12.2009

13 directories, 3 files

<http://globalweld.cr.usgs.gov/collections>

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Climate year 2011

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Annual '2011

January '2011
February '2011
March '2011
April '2011
May '2011
June '2011
July '2011
August '2011
September '2011
October '2011
November '2011

Climate year 2010

Annual '2010

December 2009
January 2010
February 2010
March 2010
April 2010
May 2010
June 2010
July 2010
August 2010
September 2010
October 2010
November 2010

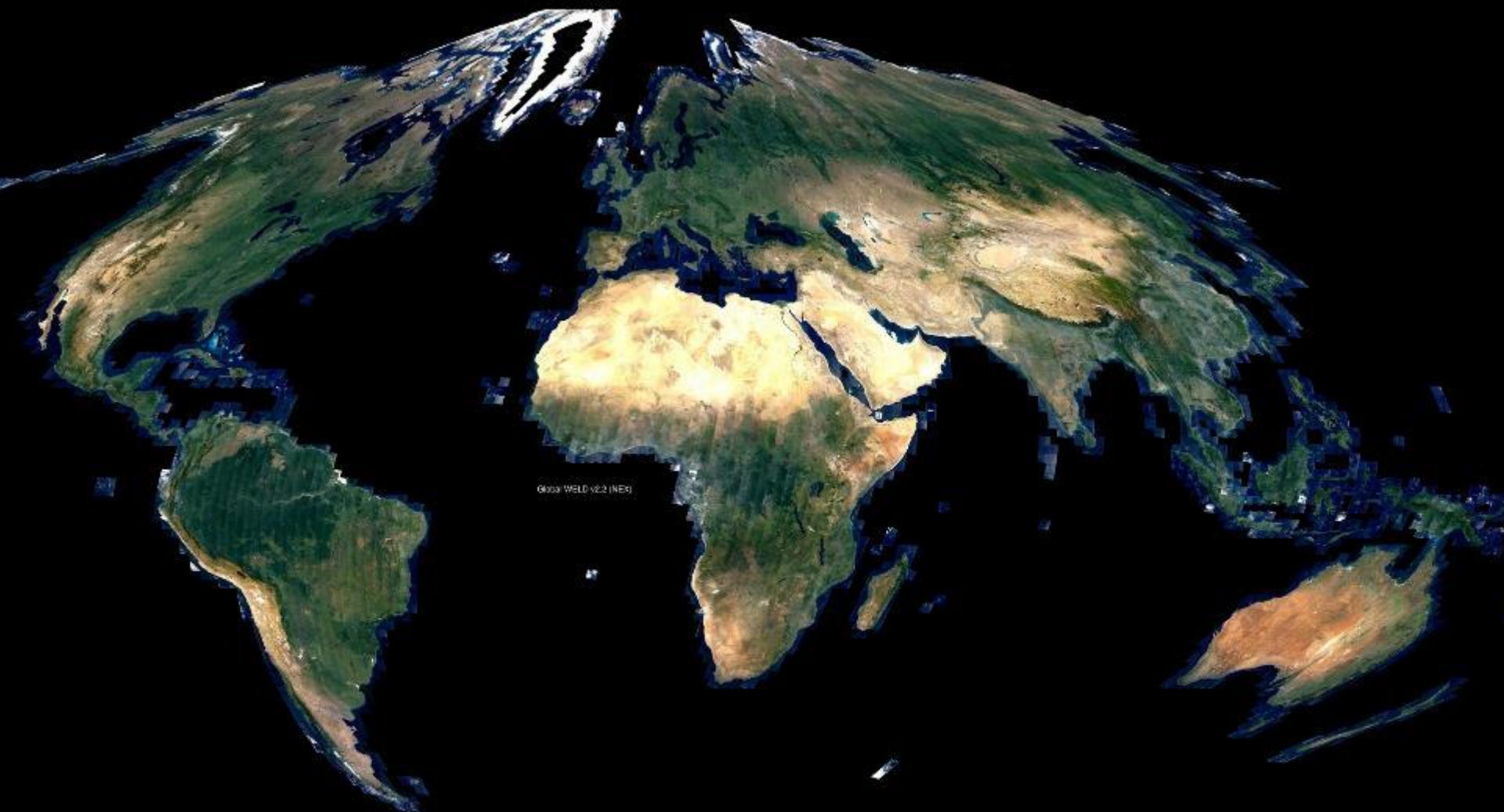
Climate year 2009

Annual '2009

January '2009
February '2009
March '2009
April '2009
May '2009
June '2009
July '2009
August '2009
September '2009
October '2009
November '2009

Global WELD NEX Processing annual 2010

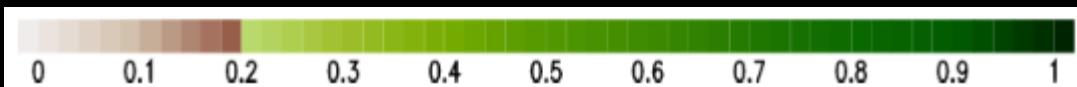
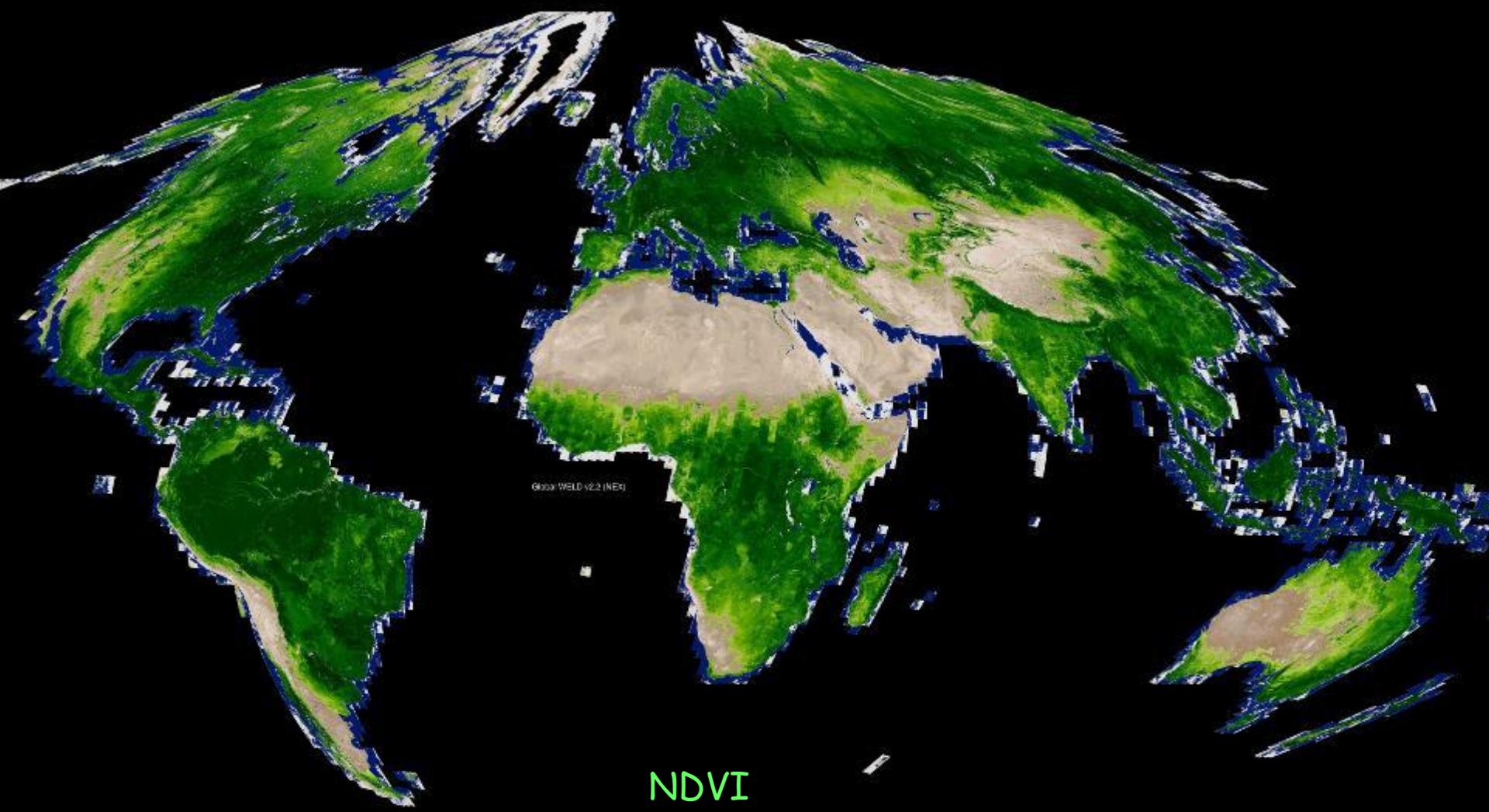
124,433 L1T scenes (45,711 Landsat 5 & 78,722 Landsat 7)



MODIS sinusoidal projection
29,652 x 14,826 1.35km browse pixels

Global WELD NEX Processing annual 2010

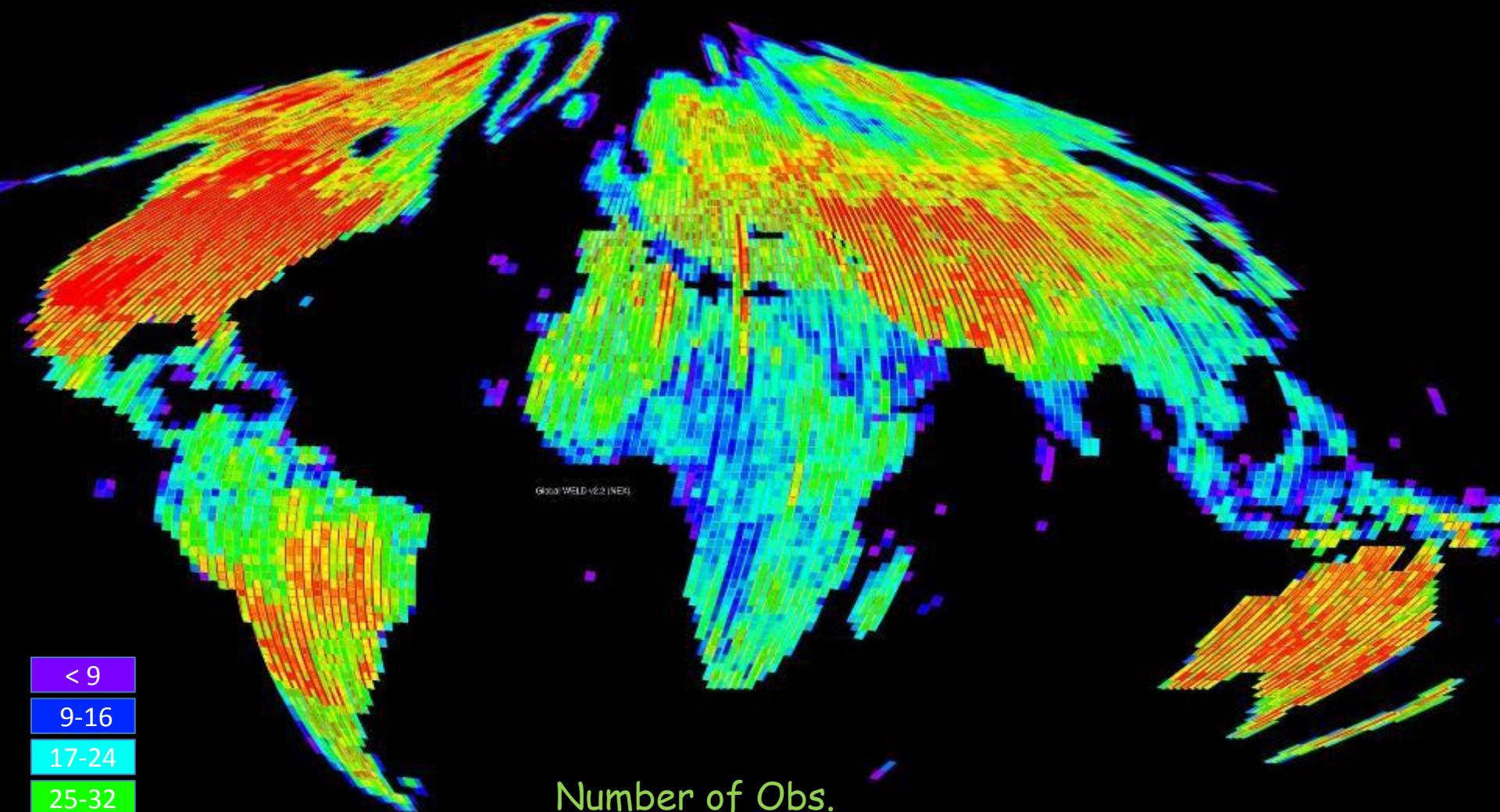
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Global WELD NEX Processing annual 2010

124,433 L1T scenes (45,711 Landsat 5 & 78,722 Landsat 7)



MODIS sinusoidal projection
29,652 x 14,826 1.35km browse pixels

Landsat 8 L1T cloud and cirrus product quality assessment - a CONUS one year analysis

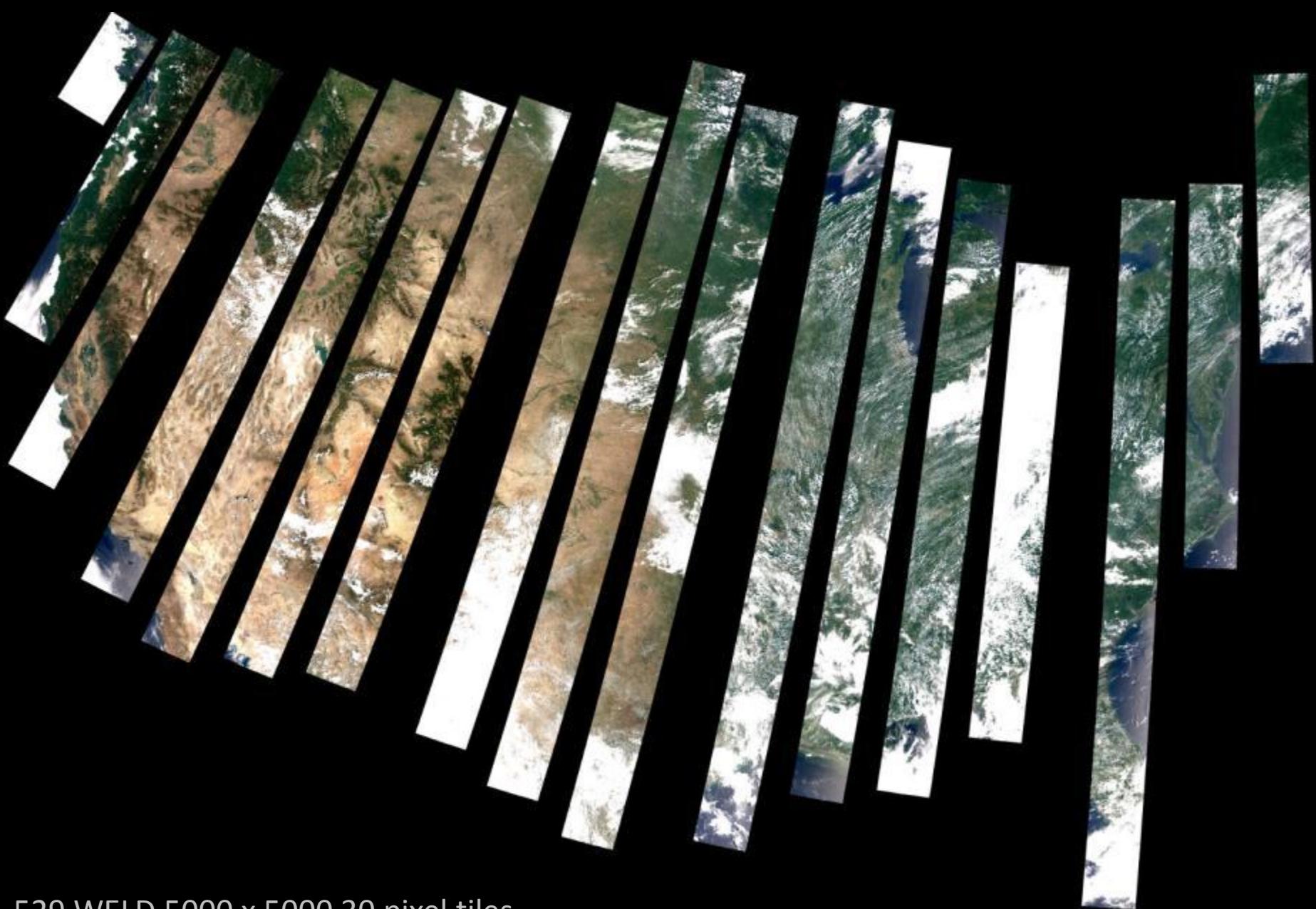
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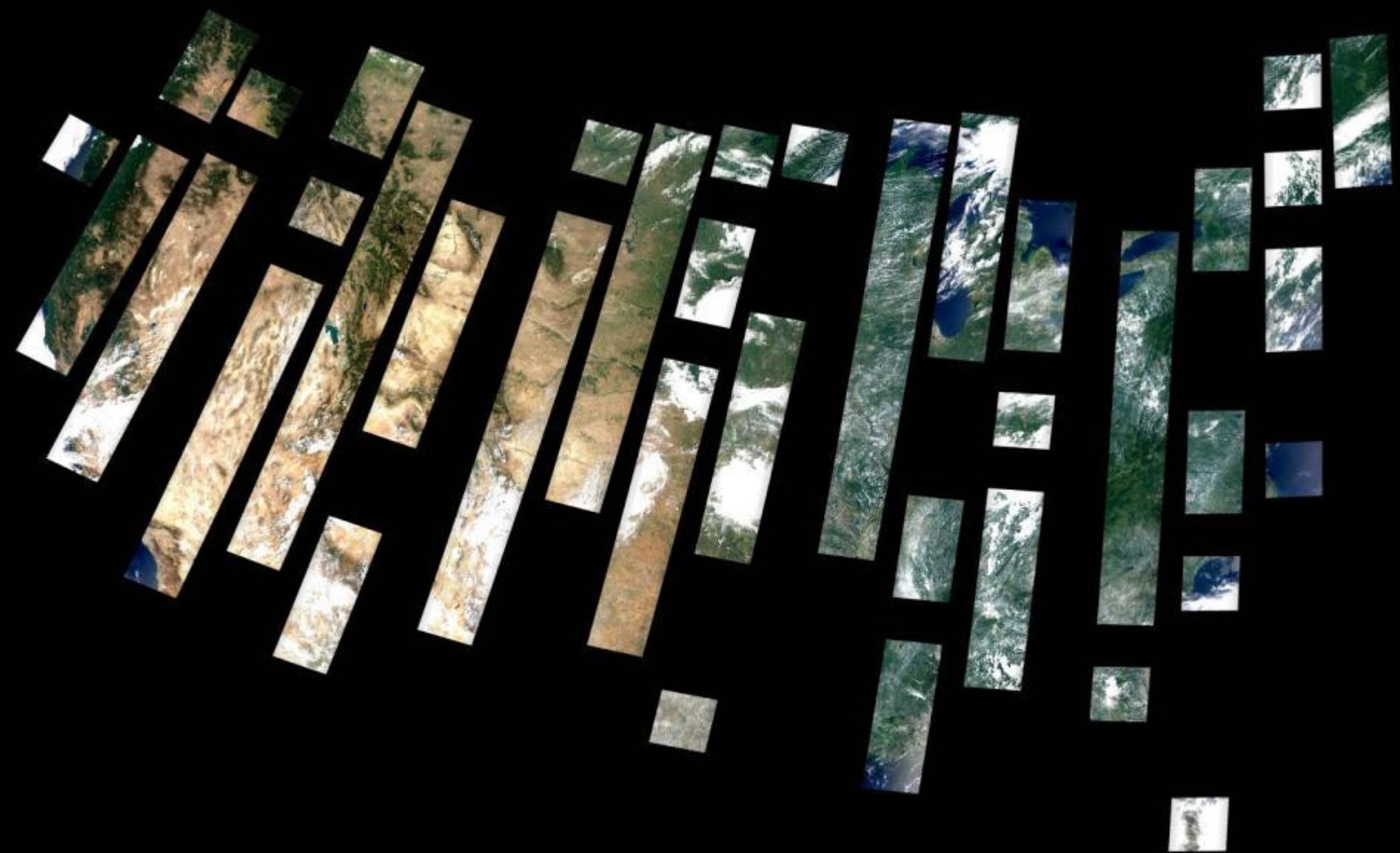


CONUS Landsat 8 Week 29 (July 16-22 2013) TOA ρ



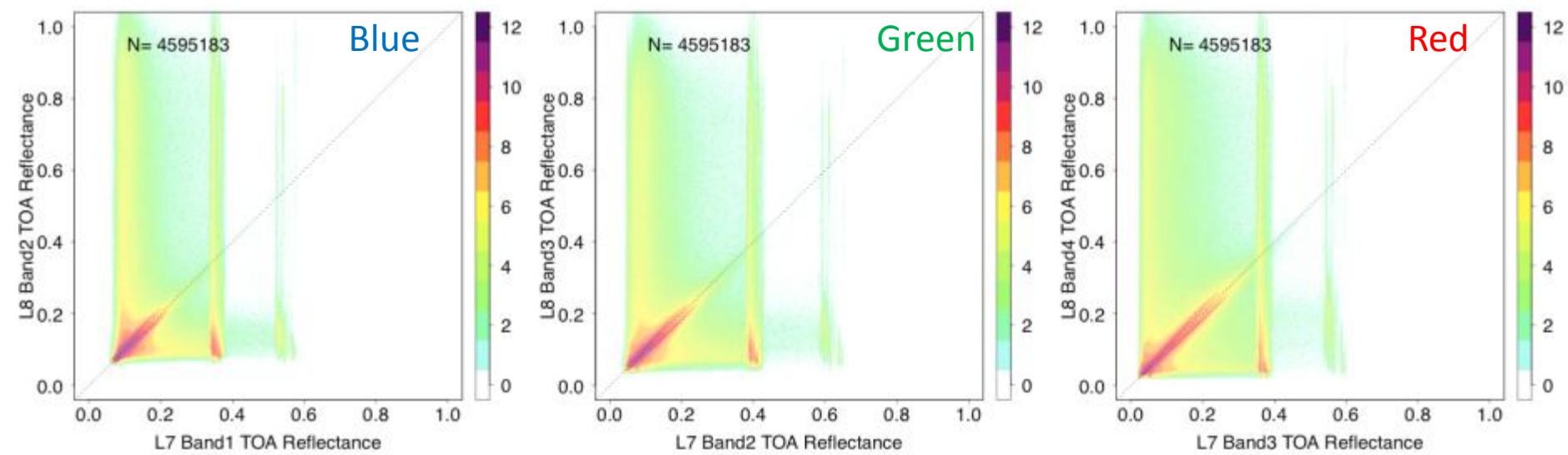
529 WELD 5000 x 5000 30 pixel tiles

CONUS Landsat 7 Week 29 (July 16-22 2013) TOA ρ



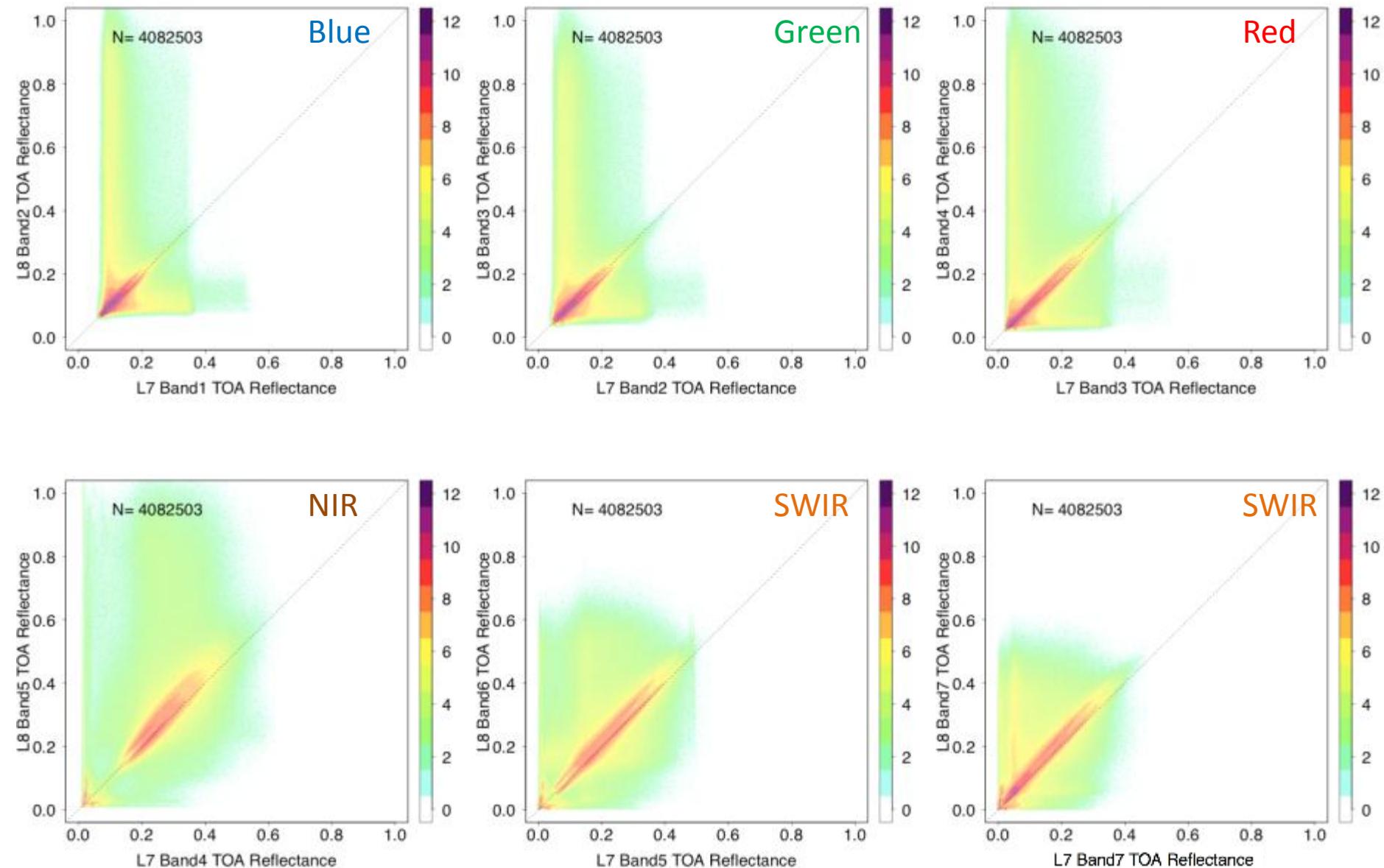
529 WELD 5000 x 5000 30 pixel tiles

Landsat 8 versus Landsat 7 TOA ρ
July, CONUS, sampled every 40 pixels East & South
no pixels discarded



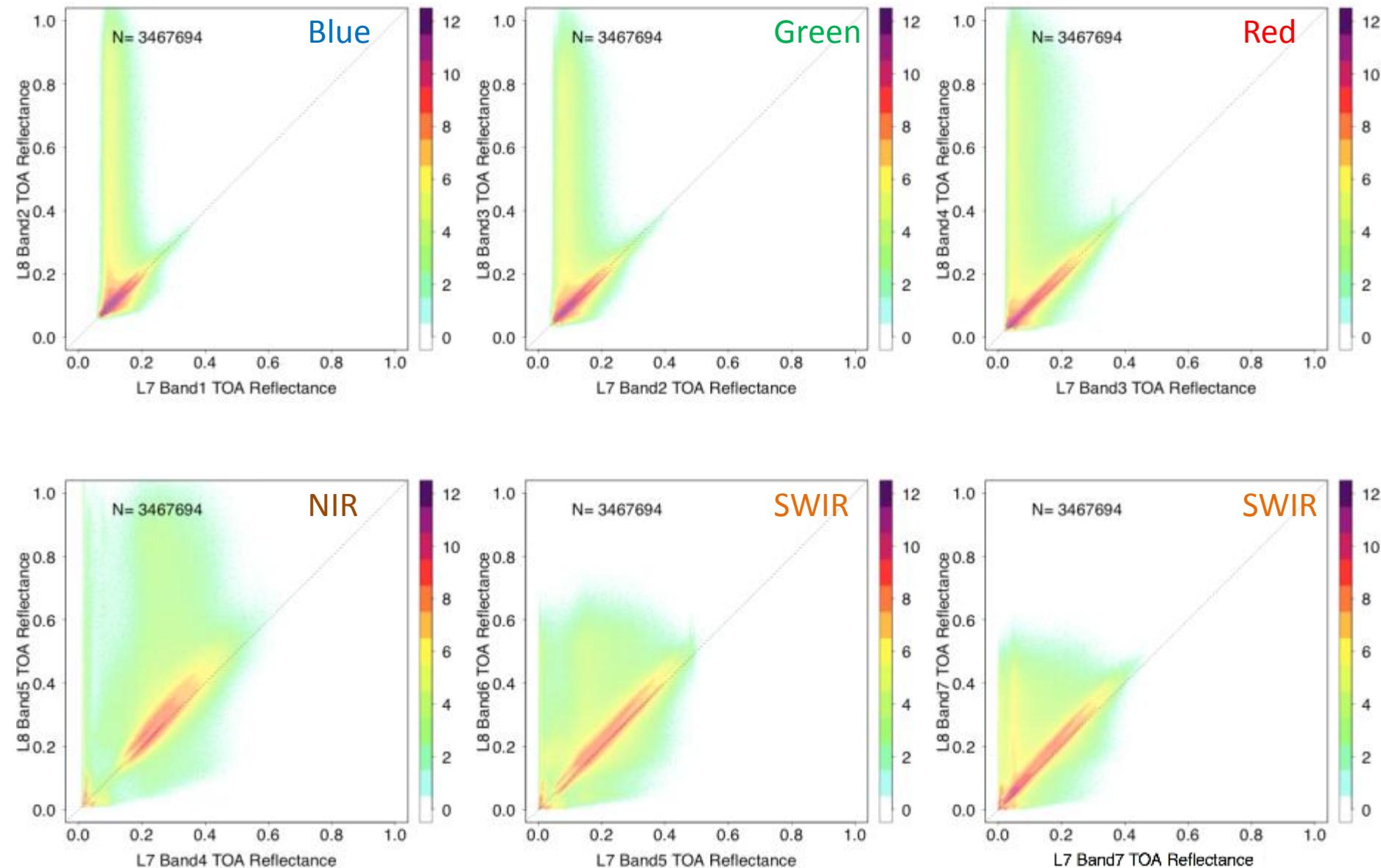
Landsat 8 versus Landsat 7 TOA ρ

July, CONUS, sampled every 40 pixels East & South
saturated pixels discarded



Landsat 8 versus Landsat 7 TOA ρ

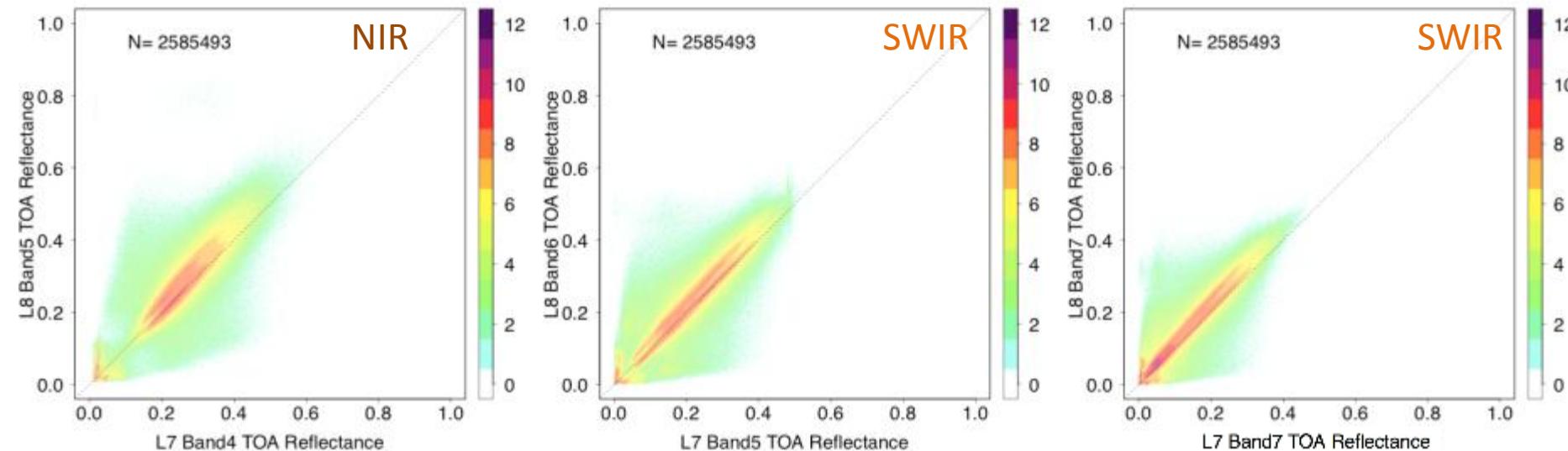
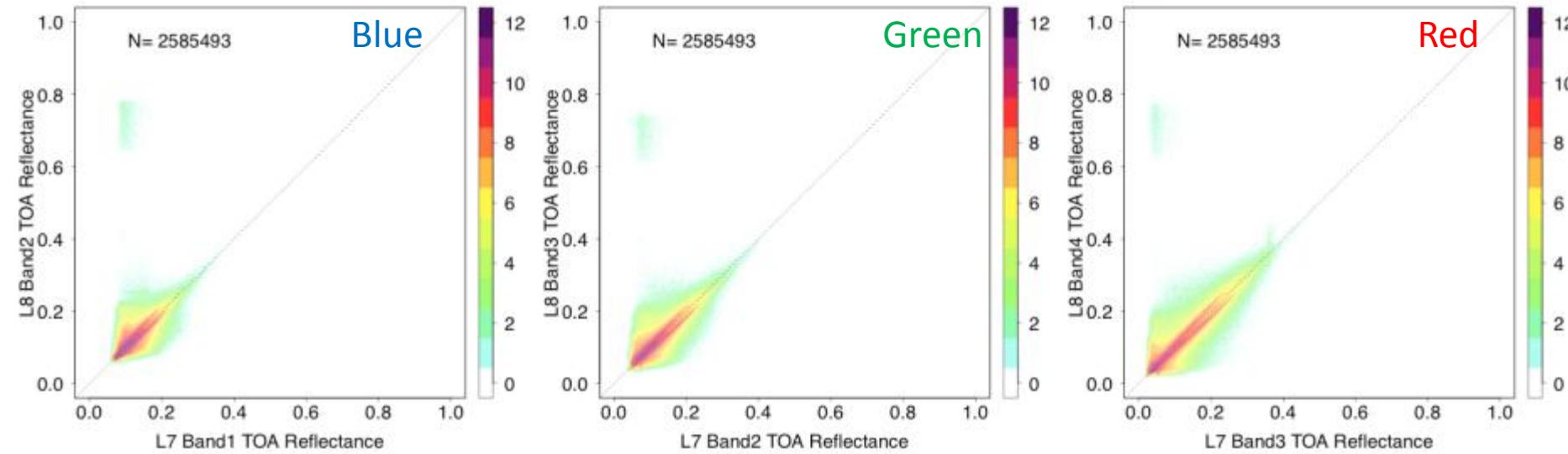
July, CONUS, sampled every 40 pixels East & South
saturated & Landsat 7 cloudy pixels discarded



Landsat 8 versus Landsat 7 TOA ρ

July, CONUS, sampled every 40 pixels East & South

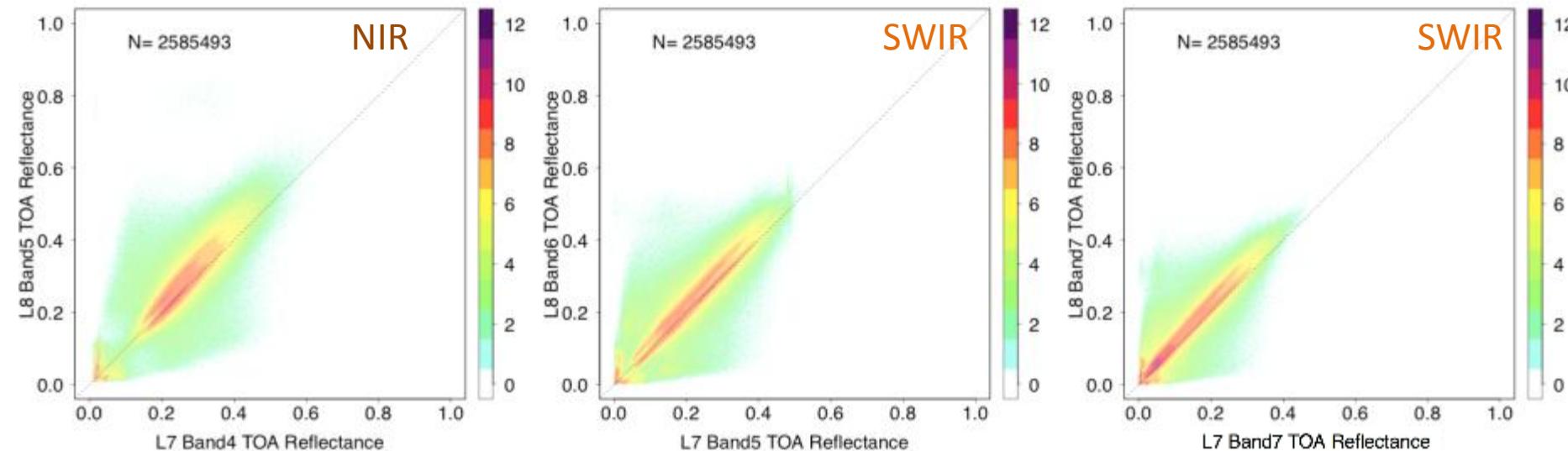
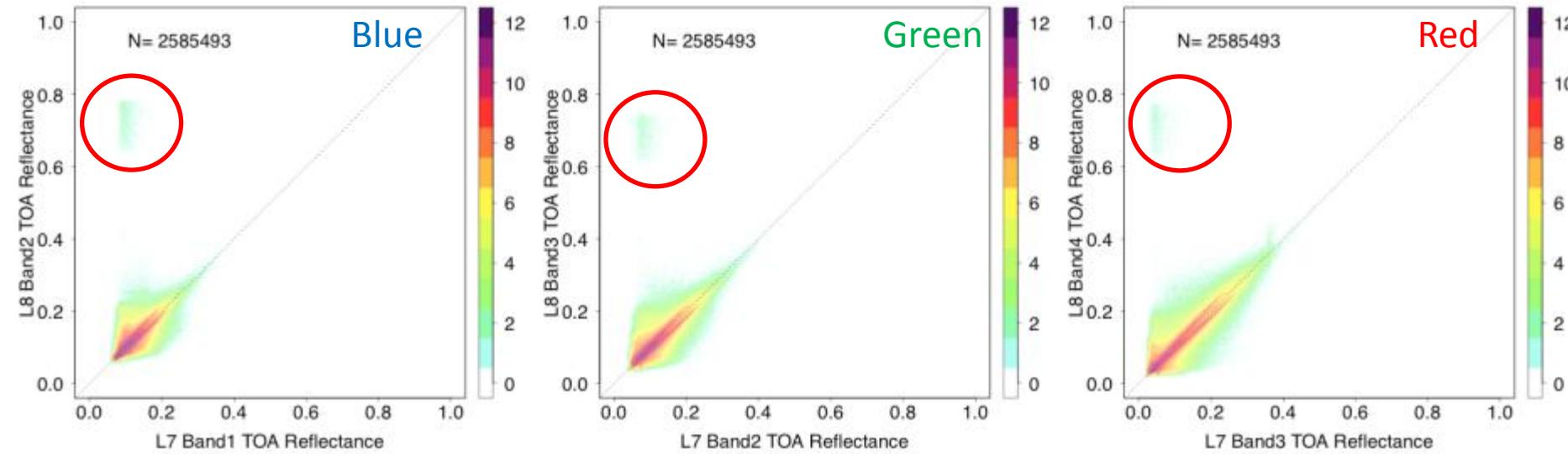
saturated & Landsat 7 & Landsat 8 cloudy/cirrus pixels discarded



Landsat 8 versus Landsat 7 TOA ρ

July, CONUS, sampled every 40 pixels East & South

saturated & Landsat 7 & Landsat 8 cloudy/cirrus pixels discarded



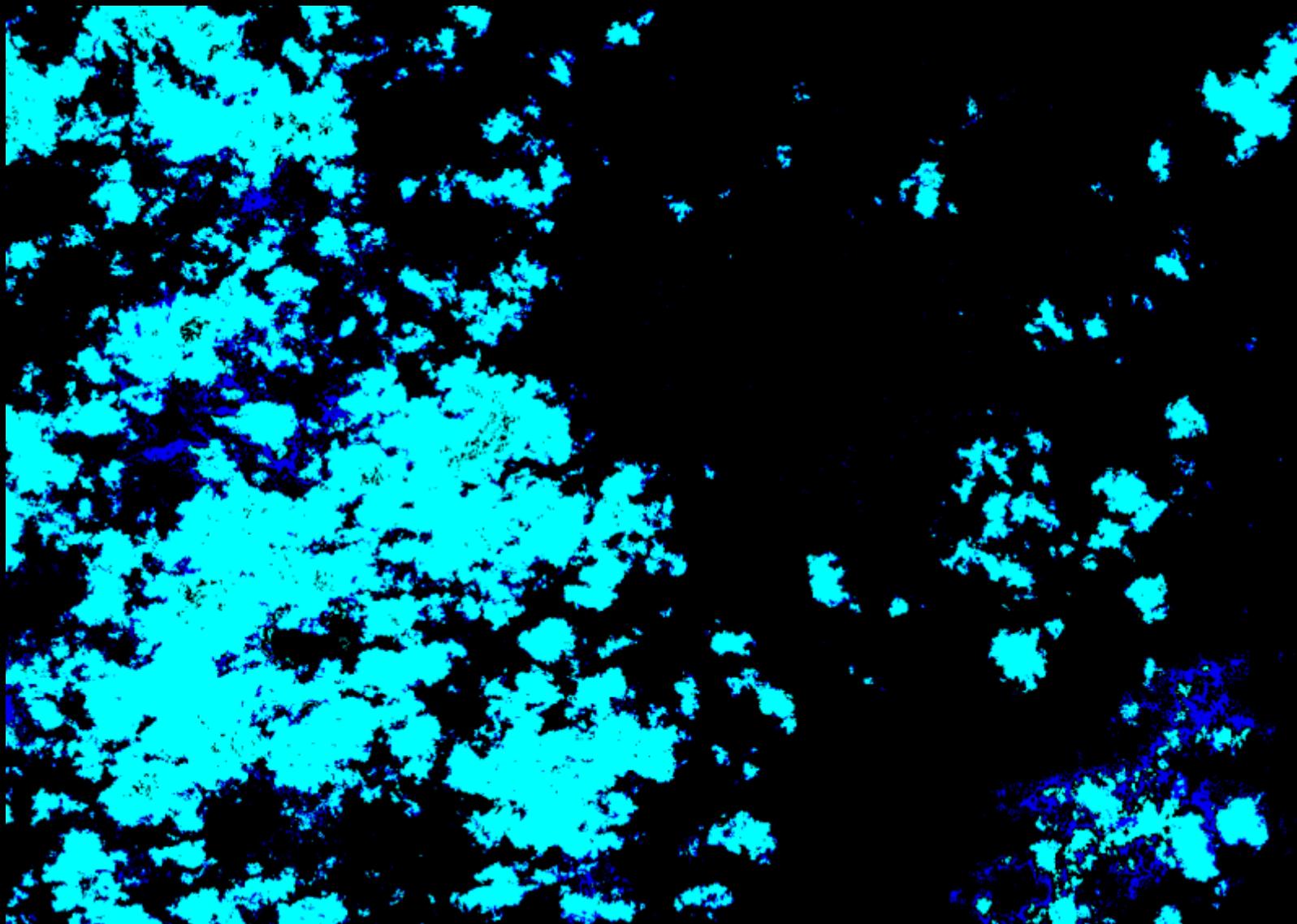
CONUS Landsat 8 Week 29 (July 16-22 2013) TOA ρ



1250 x 900 30m pixels

CONUS Landsat 8 Week 29 (July 16-22 2013) TOA ρ

High, Medium, Low confidence cloud mask

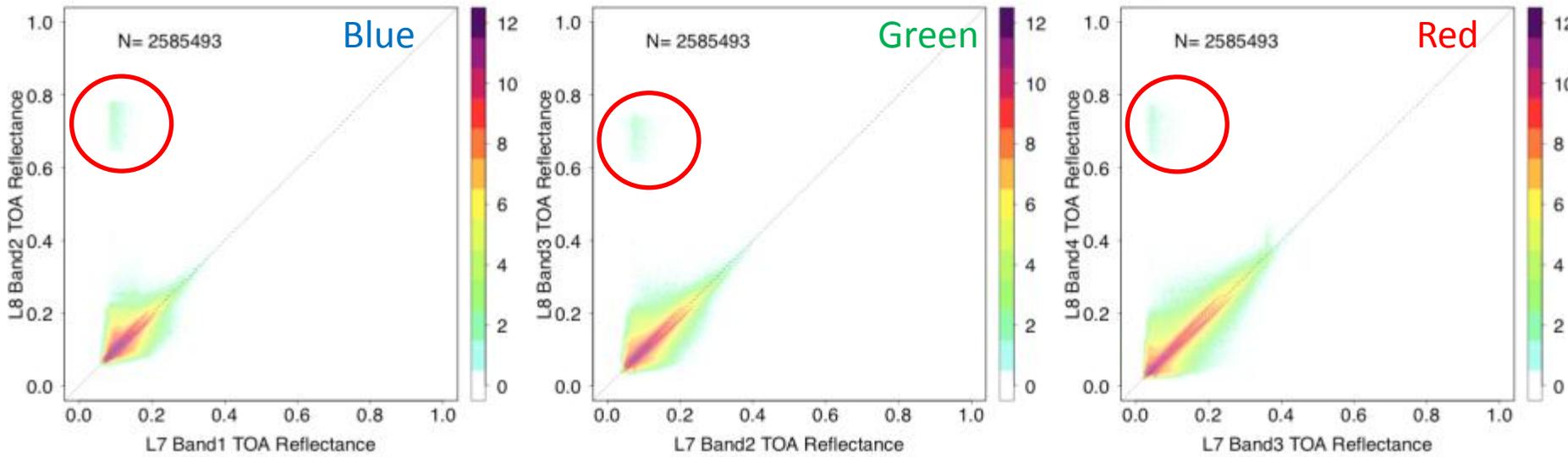


1250 x 900 30m pixels

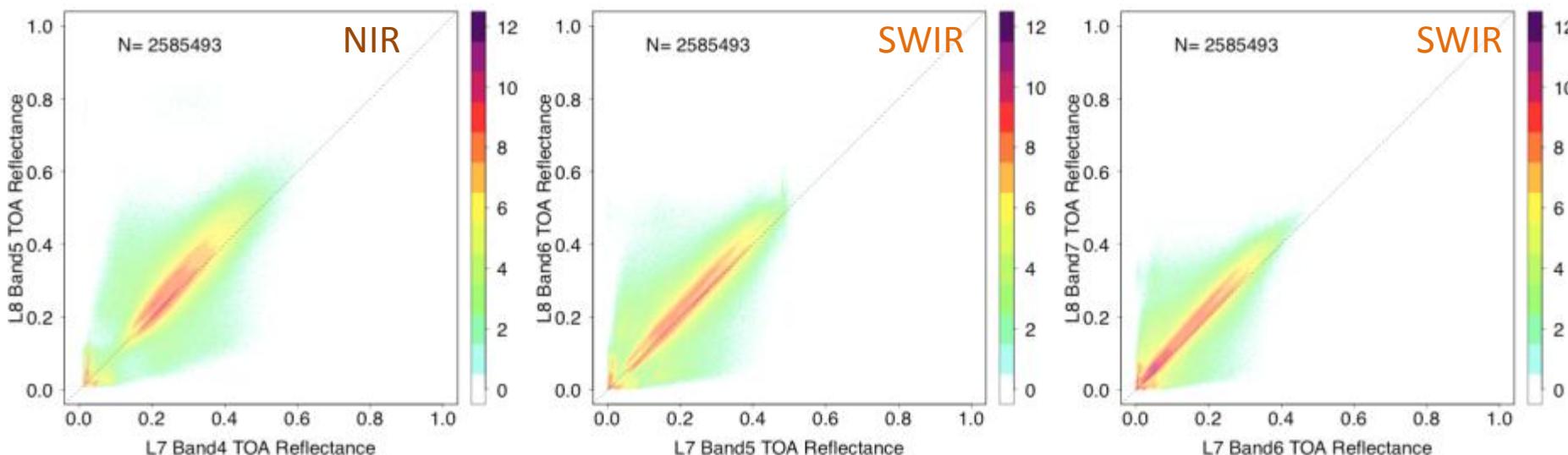
Landsat 8 versus Landsat 7 TOA ρ

July, CONUS, sampled every 40 pixels East & South

saturated & Landsat 7 & Landsat 8 cloudy/cirrus pixels discarded



Cloud omission error $\sim 0.3\%$ of the 2.6 million July CONUS pixels considered



CONUS Landsat 8 Week 29 (July 16-22 2013) TOA ρ



1250 x 900 30m pixels

CONUS Landsat 8 Week 29 (July 16-22 2013) TOA ρ

High, NO Medium, Low cirrus confidence cloud mask

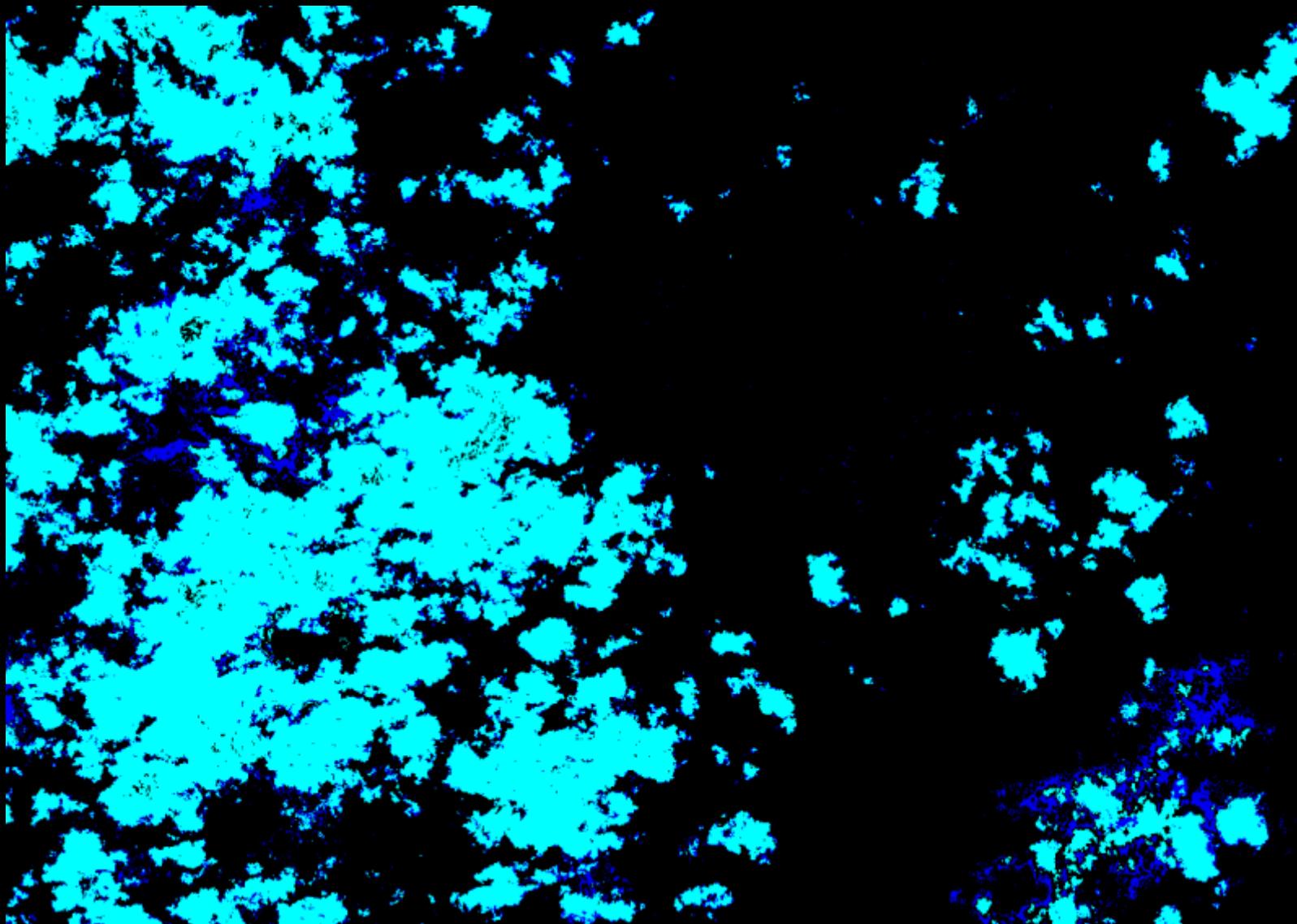


High cirrus: If (band 9 $\rho > 0.2$)

1250 x 900 30m pixels

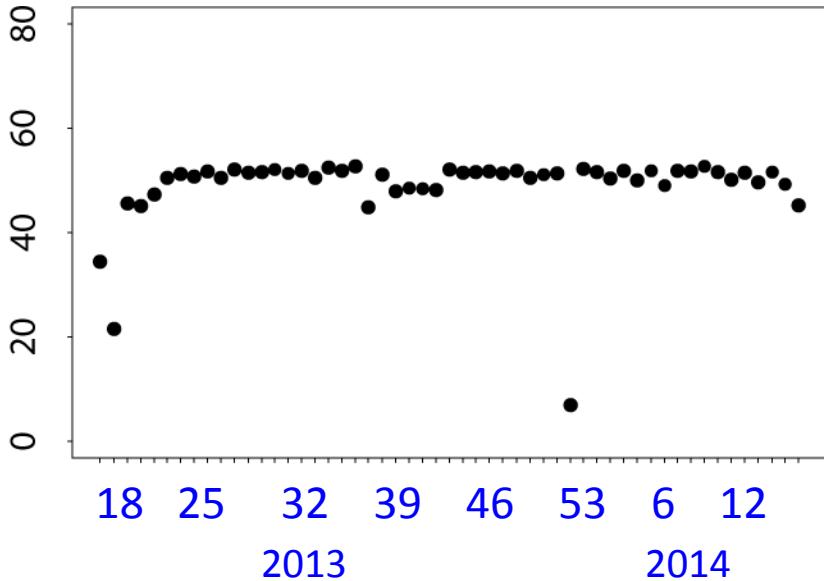
CONUS Landsat 8 Week 29 (July 16-22 2013) TOA ρ

High, Medium, Low confidence cloud mask



1250 x 900 30m pixels

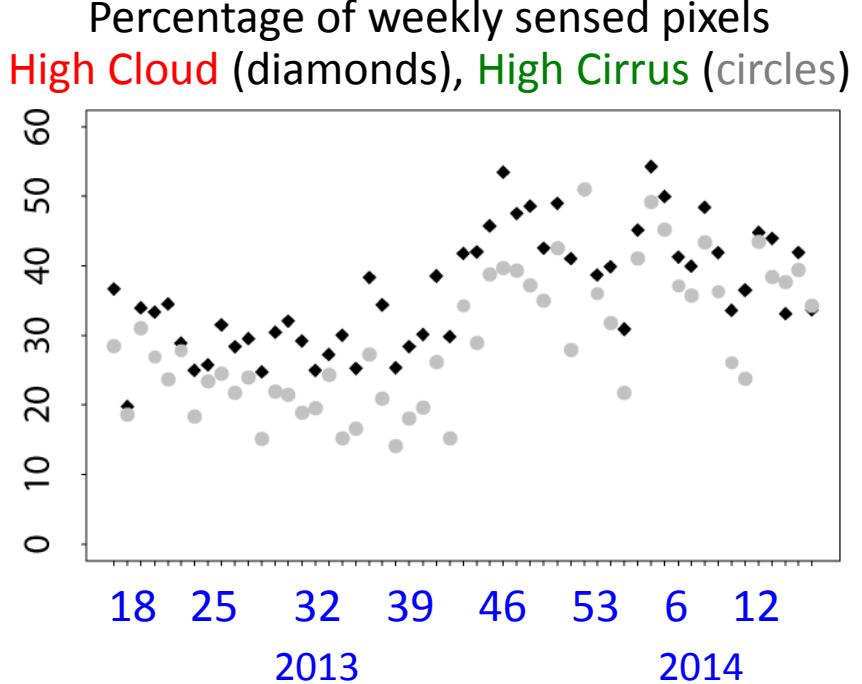
Percentage of CONUS WELD weekly tile pixels sensed (53 weeks)



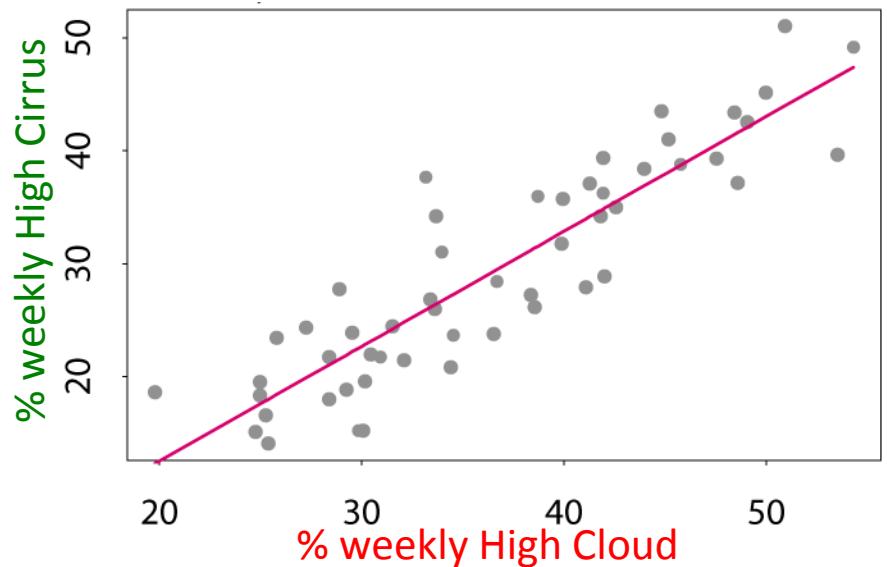
Landsat 8 CONUS weekly cloud & cirrus analysis for first year of reprocessed L1T data (using the TIRS bias adjusted reprocessed L8 data)

Landsat 8 CONUS weekly cloud & cirrus analysis for first year of reprocessed L1T data

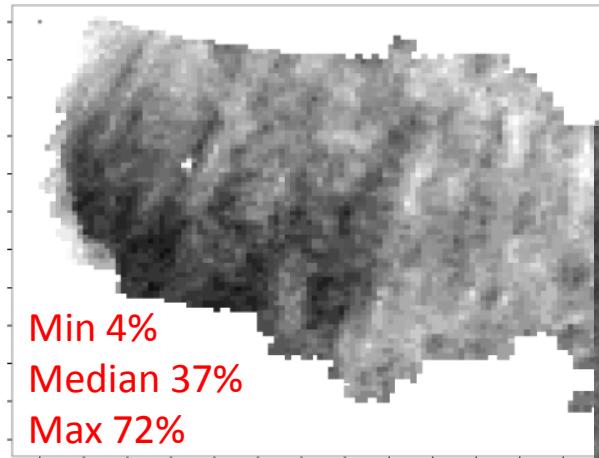
(using the TIRS bias adjusted
reprocessed L8 data)



$$\% \text{H Cirr} = -7.84 + 1.02 \% \text{ H Cld} \quad (R^2 0.89, n 53)$$



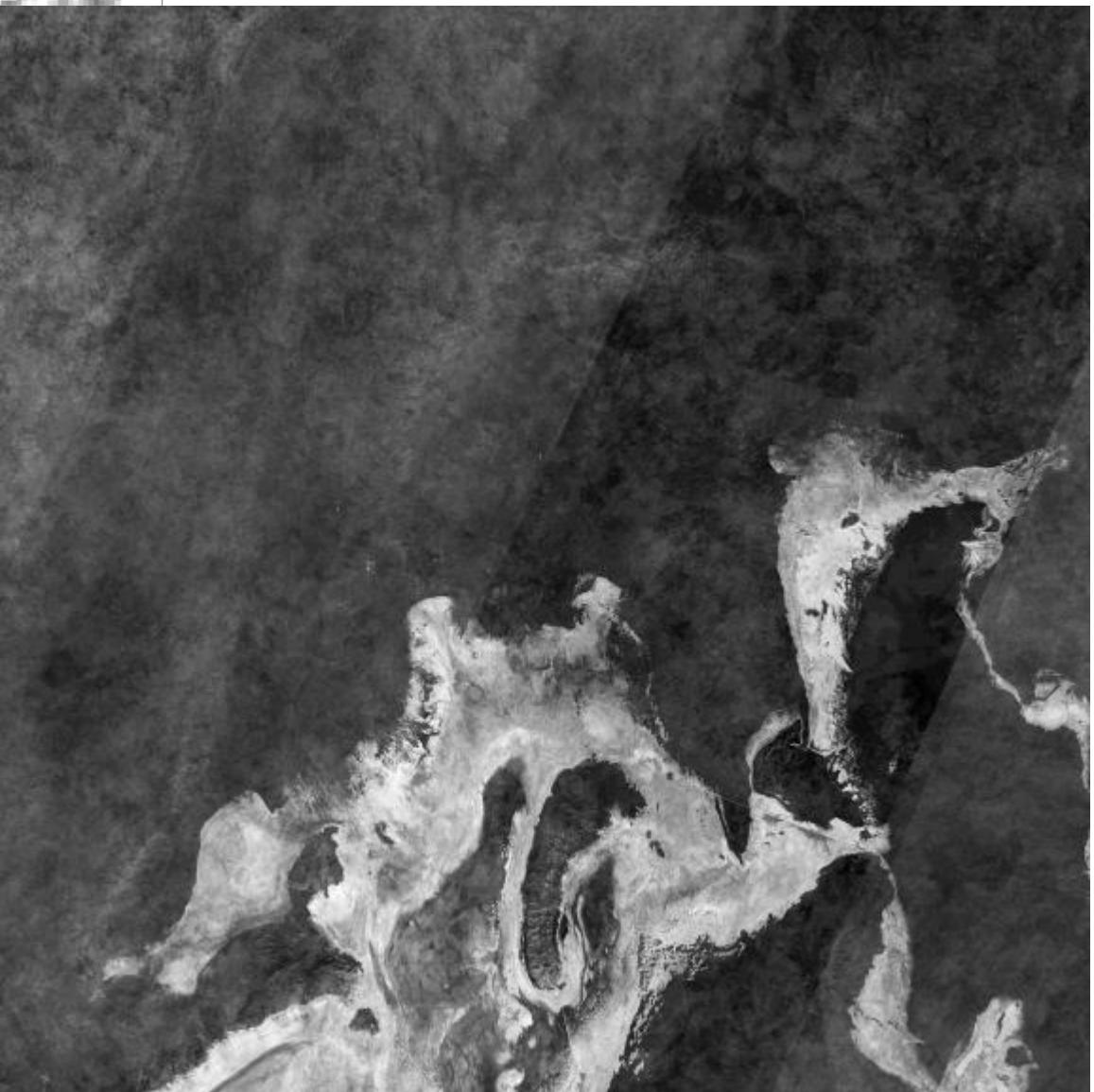
Median weekly High Cloud %
for each 1/16 5000 x 5000 30m WELD tile



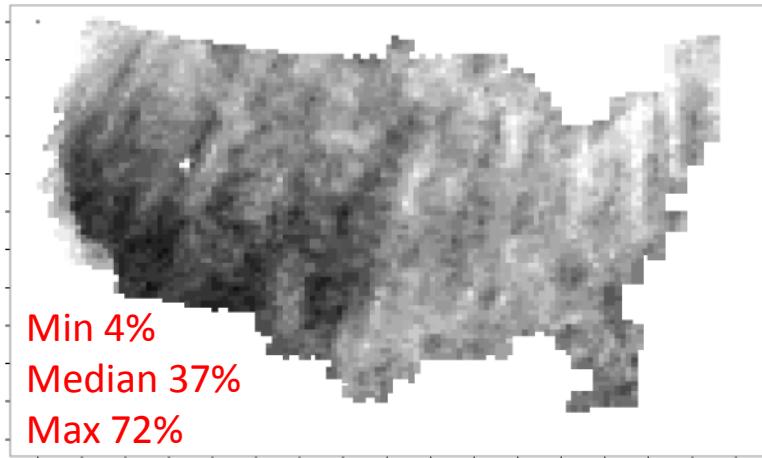
5000 x 5000 30m
WELD tile
Salt Lake

Percent of sensed
pixels over year
labeled as
High Cloud

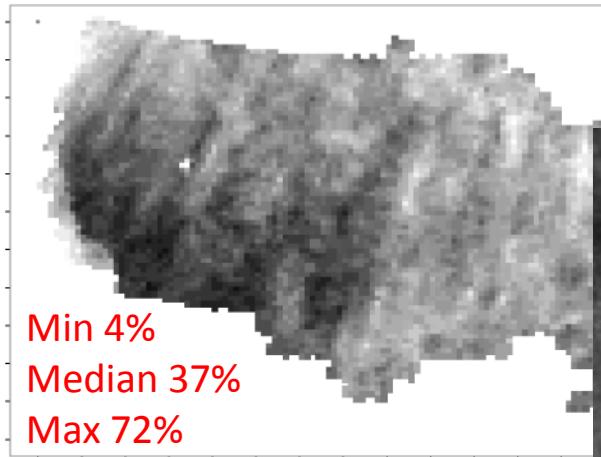
Commission Errors !



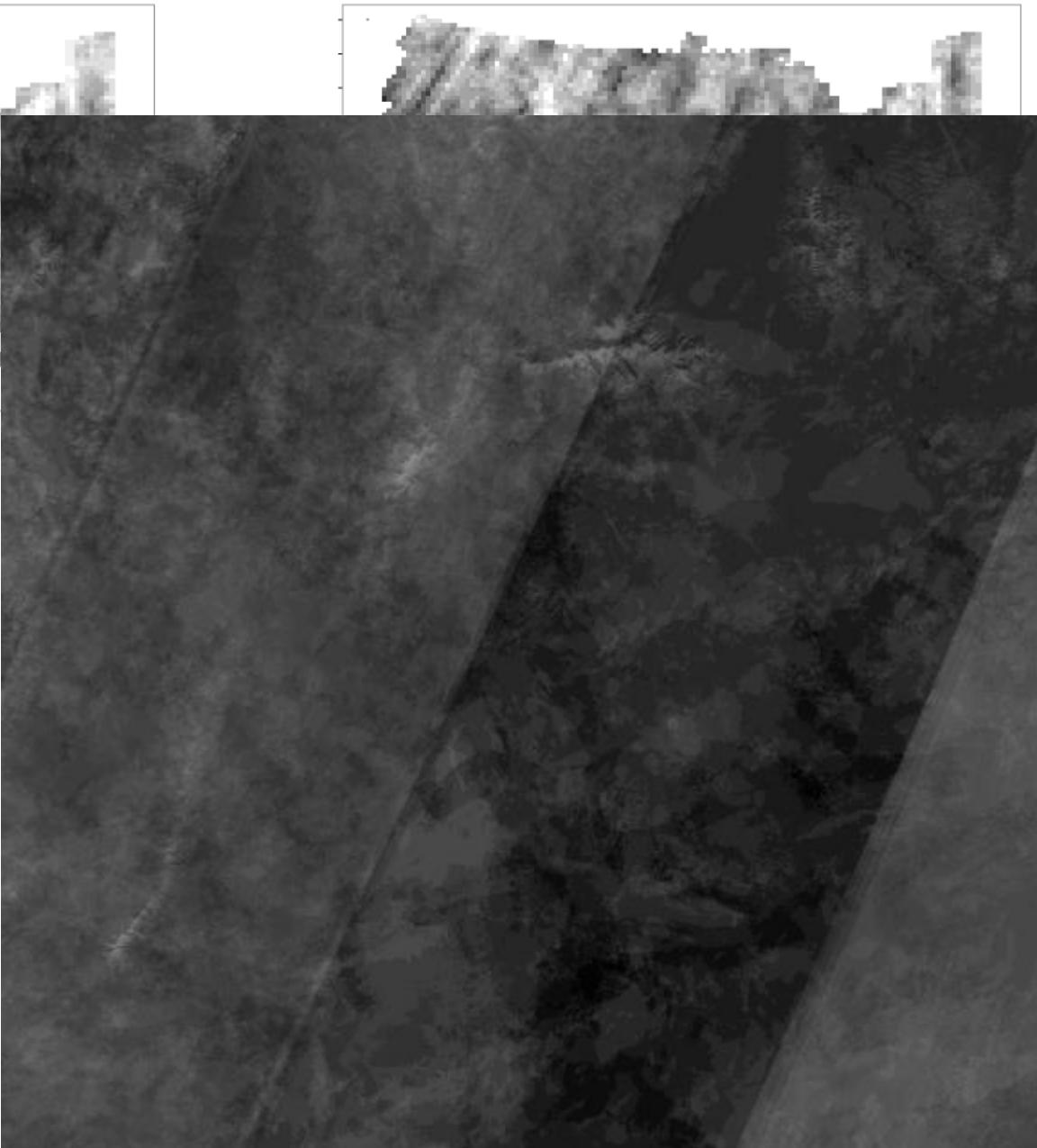
Median weekly High Cloud %
for each 1/16 5000 x 5000 30m WELD tile



Median weekly High Cloud %
for each 1/16 5000 x 5000 30m WELD tile



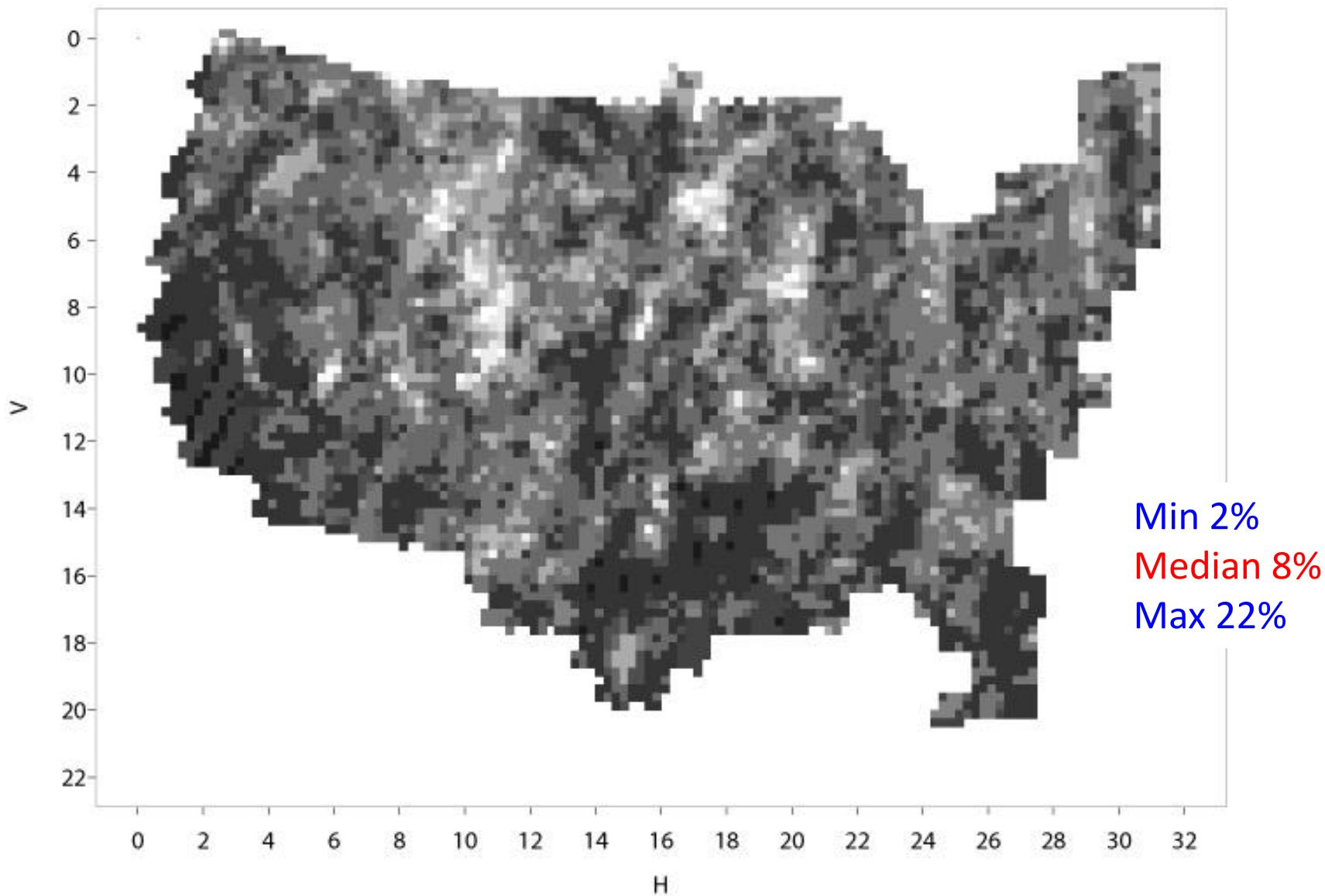
Median weekly High Cirrus %
for each 1/16 5000 x 5000 30m WELD tile



5000 x 5000 30m
WELD tile
Salt Lake

Percent of sensed
pixels over year
labeled as
High Conf. Cirrus

Median weekly **High Conf. Cirrus** **but not High Conf. Cloud** percent
for each 1/16 5000 x 5000 30m WELD tile



Summary: Landsat 8 L1T cloud and cirrus product quality assessment - a CONUS one year analysis

- **Synoptic CONUS observations**
 - Landsat 8 high & moderate confidence cloud patterns match published Landsat 7 patterns
 - ~8% of pixels High Confidence Cirrus but not High Confidence Cloud
 - illustrates the need for Landsat 8 Cirrus mask
 - implies that ~8% of Landsat 1-7 CONUS data are cirrus contaminated
- **Recommendation: Landsat 8 Level 1T cloud product further QA and alg. refinement by USGS**
 - omission errors
 - High confidence cloud - related to algorithm / classification tree split (evident in spectral scatterplots) ?
 - commission errors
 - High confidence cloud observed over certain bright surfaces (Salt Lake, also some urban areas not shown)
 - cirrus algorithm (band 9 $\rho > 0.2$) may be overly simplistic
 - online documentation for L1T product needed !
- Landsat 8 WELD compositing algorithm now less reliant on the L1T cloud and cirrus product